

Climate change and dengue transmission in Vietnam: an integrated assessment

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Valorisation

At the core of the valorisation process is the notion of translation of knowledge into products and services. The topic of our research thesis was the translation of information on the direct or indirect impacts of climate change into the transmission of dengue fever in Hanoi. The thesis consists of five empirical chapters, a theory chapter, a methodology chapter plus the introduction and conclusions chapter.

It is motivated by the observation that even increases in dengue incidence and severity are related to many factors including urbanization, increasing migration from rural to urban areas, mobility of people up and down the city, habitat pollution, floods, and climate factors such as temperature, rainfall, and humidity, little attention on these impacts, especially for the impact of climate change is being given by the Government of Vietnam. The purpose of this study is to contribute to the literature on the relative importance of social and ecological variables in the transmission cycles of DF that will be aid into public health planning and policy making. Based on that, the Vietnamese Government will develop effective strategies to control this increasingly wide-spread disease. Although the research for this thesis was conducted only in Hanoi, a city with a typically sub-tropical climate and considered an endemic region where large dengue outbreaks occur, our findings show potential for application to other similar contexts. Our thesis provided some main messages. A model-based dengue early warning system that uses climatic variables would provide evidence-based or scientific estimation of the risk of dengue in future weeks or months, estimate risk of dengue using a long period of historical data. Using weekly aggregated data of dengue incidence and four climatic variables, we found temperature,

rainfall, and vapor pressure have strong seasonality, while DF and relative humidity show both strong seasonality and a sub-annual periodicity. Temperature, rainfall and vapor pressure lead DF incidence by a lag of 8-10 weeks, constant through time. Relative humidity leads DF by a constant lag of 18 weeks for the annual cycle and a lag decreasing from 14 to 5 weeks for the sub-annual cycle. The estimation from the Vietnam National Centre for Hydro-Meteorological Forecasting showed that the average temperature in Hanoi has the tendency to rise overtime. According to the high emission scenario (A2), the yearly temperature in 2020 in Hanoi should increase by about 0.7°C , or by 0.5°C according to medium (B2) and low emission scenarios (B1). In 2030, this increase according to high, medium and low emission scenarios would be 0.9°C , 0.8°C and 0.7°C respectively. Evidence is accumulating from many studies including ours about the relationship between climate change and DF. The statistical numbers estimated from three scenarios in Hanoi have clearly warned about a continued increase of DF epidemics in Hanoi in the future. The rising of the climatic variables and the time distance between climatic variables and DF could be indicators for a warning of increasing risk of dengue cases for the local authorities. The primary audience for our research are policy makers in the public health sector. Therefore, public health authorities in Hanoi should be prepared for controlling the continuing increase of DF in the future. Our thesis also demonstrated that the DF reproductive ratio is increasing through time and displays two clear peaks per year, reflecting the sub-annual periodicity of DF incidence. The results are interpreted in terms of mosquito population dynamics and immunological interactions between the different dengue serotypes in the human compartment. Given its important population size, its strong seasonality and its dengue emergence, Hanoi offers an ideal natural experiment to test hypotheses on dengue serotype interactions, knowledge that is of prime importance for vaccine development.

Climate change should not stand alone, it should be considered within the context of the socio-demographic, economic and immunological determinants that

contribute to the spread of dengue. The other message in our thesis is about the essential role of environmental factors in the increased incidence and prevalence of DF. We found that people living near bodies of stagnant water, like ponds, lakes and rivers or open sewers, or near favorable mosquito breeding places like garbage collection points, had higher rates of morbidity. We also detected the presence of long term hotspots of DF occurrence in six districts of Hanoi where has higher population density. These findings can provide public health officials with necessary information, thus enabling them to chalk out more effective strategies to control DF. Furthermore, our thesis provides a message to Hanoi Preventive Medicine Center that hotspot analysis for DF should be widely used in DF surveillance, since it can help them to allocate resources to deal with outbreaks more effectively.

Another target group in our research is the community members. As the results revealed that many of them still had incorrect ideas about climate change and little awareness about links between climate change and human health, more effort is needed to raise awareness that climate change is a public health issue. A high level of awareness on the links between global environmental change and human health may help to increase the success of the National Prevention Program on Climate Change. The Program should also make use of community groups as climate change community channels, especially for the more excluded groups such as women and people with lower levels of education who presently have less awareness of the issues.

Finally, the research results are valuable for the research and science community. Our research used real databases from local/national statistics stations to build up statistics model based for Hanoi a typical sub-tropical city. The successful application of a range of methods and tools demonstrated how useful they could be in describing a complex system and identifying key factors where interventions may be possible. Thus our application could show the potential of the proposed model for other similar contexts.